Federal Energy Management Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

FEMP FIRST THURSDAY SEMINARS
What you need to know...online, live, and anytime.

New Developments in Federal Building Energy Efficiency Standards

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FEMP Federal Energy Management Program

Competency Development

1. When designing a Federal building, determine which Federal Building Energy Efficiency Standards apply for the particular building type
2. Explain the relationship between the Federal Building Energy Efficiency Standards, ASHRAE 90.1, and the International Energy Conservation Code (IECC)
3. Apply the right parts of the standards (10 CFR 433 and 435) based on when the building design was initiated

Competency Development

4. When calculating the 30% energy efficiency improvement requirement, explain what is included and excluded in the calculations
5. Discuss key strategies for meeting the energy efficiency standards through aspects of building design such as building envelope, lighting, service hot water, and technology selection
6. Discuss key strategies for calculating the improvement, including whole building simulation and life cycle cost analysis

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The Basis for Federal Building Energy Efficiency Standards

EPACT 2005 Section 109 – Key Provisions

Depending on building type:

- Direct new Federal building to be designed to meet ASHRAE Standard 90.1 or the International Energy Conservation Code
- Directs new Federal buildings to be designed 30% below ASHRAE Standard 90.1 or the International Energy Conservation Code, if life cycle cost-effective

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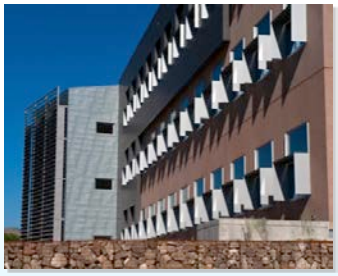
10 CFR Parts 433 and 435 Codifies Section 109 of EPACT

- 10 CFR Part 433 – Energy Efficiency Standards for **New Federal Commercial and Multi-Family High-Rise Residential Buildings**
- 10 CFR Part 435, Subpart A – Mandatory Energy Efficiency Standards for **Federal Low-Rise Residential Buildings**



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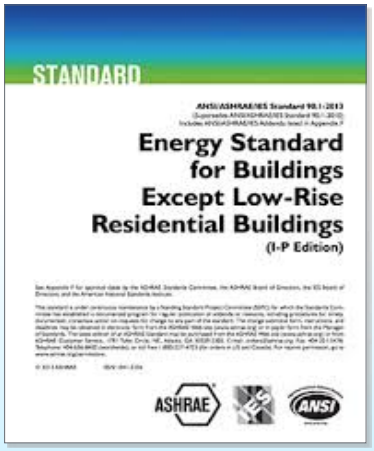
Which Building in Which Standard?

Number of stories	Sleeping accommodations that are for more than 30 days	No sleeping accommodations or short term sleeping accommodation (less than 30 days)
Three stories or less	10 CFR 435 for low-rise residential buildings	10 CFR 433 for commercial and high-rise multi-family residential buildings
More than three stories	10 CFR 433 for commercial and high-rise multi-family residential buildings	10 CFR 433 for commercial and high-rise multi-family residential buildings

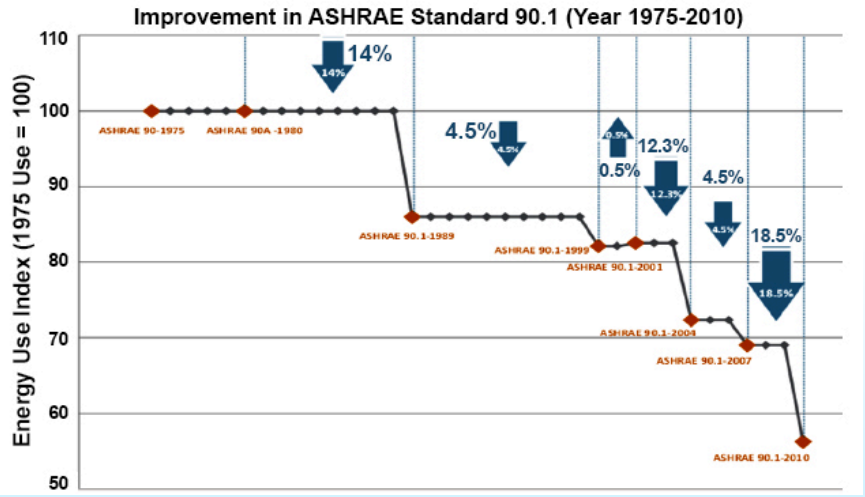
For most mixed use buildings, 10 CFR 433 is more appropriate.

ASHRAE 90.1

- Applies to buildings covered by 10 CFR 433
- Requirement is to achieve energy consumption levels that are at least 30 percent below levels established in the referenced codes **"if life cycle cost-effective"**



ASHRAE Standard 90.1 Over Time

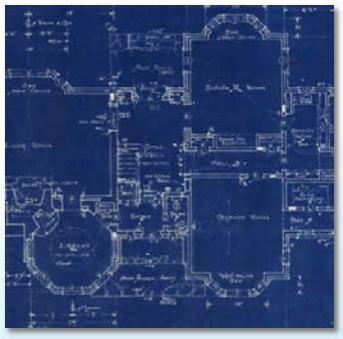


Which Version of ASHRAE 90.1 Applies

- Design for construction began on or after January 3, 2007 and before August 10, 2012
  - **ASHRAE 90.1-2004**
- Design for construction began on or after August 10, 2012 and before July 9, 2014
  - **ASHRAE 90.1-2007**
- Design for construction begins on or after July 9, 2014
  - **ASHRAE 90.1-2010**

Definition of Design for Construction

The stage when the energy efficiency and sustainability details (such as insulation levels, HVAC systems, water-using systems, etc.) are either explicitly determined or implicitly included in a project cost specification.



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New Requirements for Standard 90.1-2010 (10 CFR 433 Baseline Standard)

- Increased stringency in building envelope
- Lowered interior lighting power densities
- Additional occupant sensing controls
- Mandatory daylighting requirements
- New five-zone exterior lighting power density table

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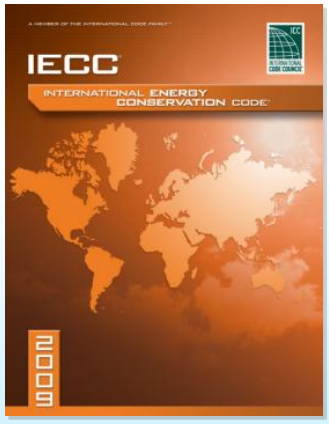
New Requirements for Standard 90.1-2010 (10 CFR 433 Baseline Standard)

- Higher equipment efficiencies
- Additional requirements for energy recovery, economizers, and more energy-conserving controls
- Expands scope to cover receptacles and some process loads
- Clarification of and expansion of modeling requirements

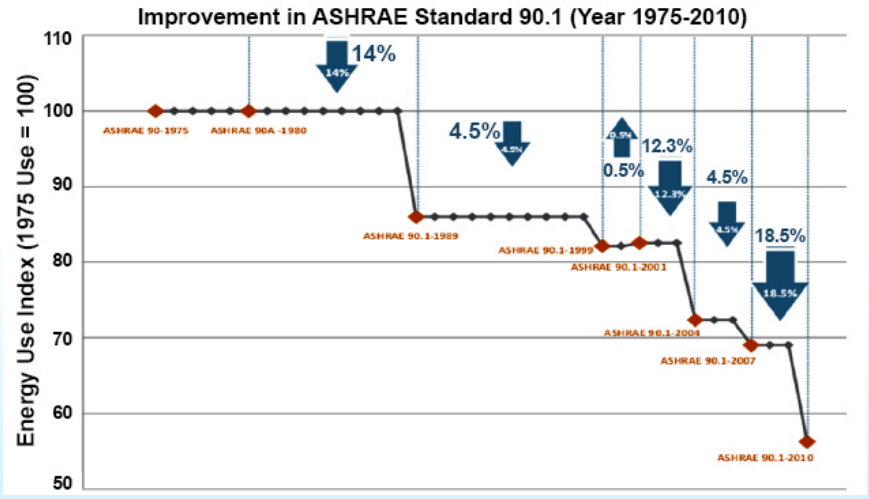
International Energy Conservation Code (IECC)

- Applies to 10 CFR 435 for low-rise residential buildings
- Meet the IECC and achieve energy consumption levels that are at least 30 percent below levels established in the referenced codes if life cycle cost-effective



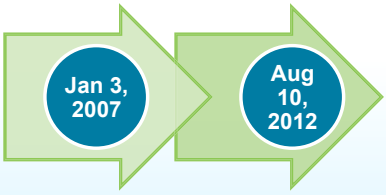
IECC Changes Over Time

Federal standard does not currently include 2012 IECC



Which IECC Standard Applies?

- Design for construction began on or after January 3, 2007 and before August 10, 2012
  - **IECC 2004**
- Design for construction began on or after August 10, 2012
  - **IECC 2009**
- IECC 2012 awaiting OMB approval



New Requirements for 2009 IECC (10 CFR 435 Baseline Standard)

- New high efficiency lighting requirement
- Increased stringency in building envelope
- More detailed air leakage requirements
- New duct leakage limits and testing requirement
- Modification of simulated performance alternative

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Meeting the Standards

Meeting the Federal Standards

10 CFR 433 and 10 CFR 435 have a two-part requirement for Federal buildings

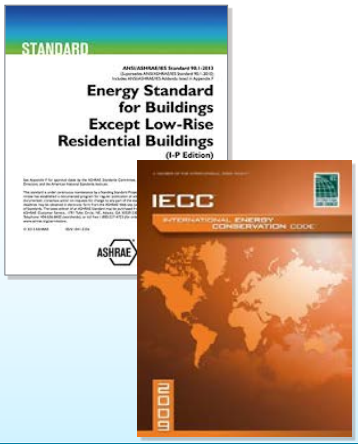
- **Part 1**
  The proposed design must meet the baseline standard
- **Part 2**
  If life cycle cost-effective, the proposed design must achieve energy conservation levels that are at least 30% below the baseline standard

Part 1 - Meeting the Baseline Standards

10 CFR 433 and 10 CFR 435 each have a baseline standard must be met.

- **10 CFR 433**
  ASHRAE Standard 90.1
- **10 CFR 435**
  ICC IECC

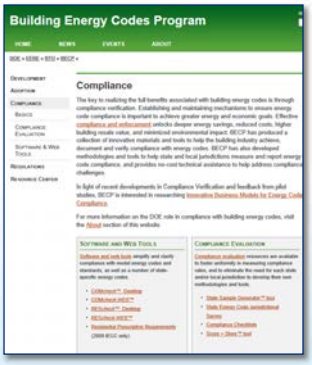
Meeting the baseline standards is not subject to life cycle costing!



Part 1- Meeting the Baseline Standards

Because ASHRAE Standard 90.1 and the ICC IECC are private sector standards, DOE's Building Energy Codes Program (BECP) has a wide variety of support material on these standards at **http://www.energycodes.gov**, including:

- **Compliance software**
- **Training through BECP's Resource Center**



Part 2 – Exceeding the Baseline Standard by 30%

The rules for what you can "credit" for towards exceeding the baseline standard by 30% are defined in:

- **Appendix G of ASHRAE Standard 90.1**
- **The Simulated Performance Alternative of the IECC**

You must understand the "rules" of **Appendix G** and the **Simulated Performance Alternative** to know which measures are eligible for "credit". You must also use whole building simulation to this "credit".

Appendix G of ASHRAE 90.1 - Getting Credit

Building Envelope

- Optimizing the orientation of building
- Use more insulation or better performing windows in the building envelope than is required in the baseline standard
- Using higher roof solar reflectance and thermal emittance than is required in the baseline standard

Appendix G of ASHRAE 90.1 - Getting Credit

Lighting Measures

- Using less interior lighting power density than is required in the baseline standard
- Using more automatic daylighting controls than are required in the baseline standard

Source: NREL

Appendix G of ASHRAE 90.1 – Getting Credit

Service Water Heating Measures

- Using higher efficiency equipment than what is required in the baseline standard
  - EnergyStar and FEMP-designated equipment
- Utilizing heat recovery beyond what is required in baseline standard

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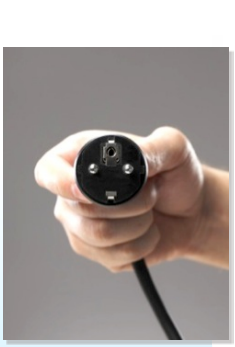
Appendix G of ASHRAE 90.1 – Getting Credit

Receptacles and Plug Loads

Take advantage of reduced plug loads required by using EnergyStar equipment



Appendix G of ASHRAE – Getting Credit

HVAC

- Using the higher efficiency equipment required
  - ✓ EnergyStar and FEMP-designated equipment
- Selecting a more efficient system (e.g., ground source heat pump)
- Fuel switching

Appendix G of ASHRAE 90.1 - Getting Credit

Renewables

- You can use renewables to meet the requirements of 10 CFR 433
- Campus-wide or base-wide renewables don't count – need to look at building-specific renewables to meet 10 CFR 433

Simulated Performance Alternative of the IECC –Getting Credit

Building Envelope

- Optimizing the orientation of building
- Use more insulation or better performing windows in the building envelope than is required in the baseline standard
- Using higher roof solar reflectance and thermal emittance than is required in the baseline standard
- Reducing the building air leakage below what is required in the baseline standard (must be tested)

Simulated Performance Alternative of the IECC – Getting Credit

HVAC and Domestic Hot Water

- No “credit” given in the Simulated Performance Alternative for improved equipment efficiency
- Agencies are still required to use EnergyStar and FEMP-designated equipment for HVAC and domestic hot water
- Improved thermal distribution system efficiency beyond what is required in the baseline standard (duct leakage testing)

Simulated Performance Alternative of the IECC - Getting Credit

Renewables

- You can use renewables to meet the requirements of 10 CFR 433
- Campus-wide or base-wide renewables don't count – need to look at building-specific renewables to meet 10 CFR 433

Getting Credit in Both 10 CFR 433 and 10 CFR 435

Bonus Credit

Rules allow you to subtract out plug loads and process loads from both the numerator and the denominator of the percentage savings equation because

- Agencies are already using high efficiency plug loads, and
- DOE did not want to penalize agencies by requiring them to achieve 30% savings on process loads

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Optimizing the Energy Efficiency of Whole Building Design

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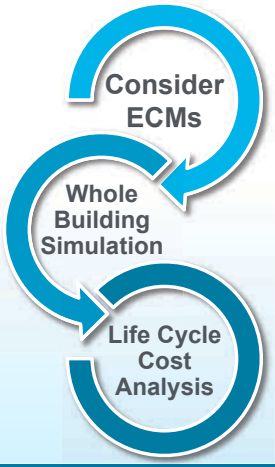
"Optimizing" Energy Efficiency of Building Design

1. Consider a number of energy conservation measures (ECMs)
2. Perform whole building simulation on a various combinations of ECMs
3. Perform life cycle cost-analysis on all combinations to identify the combination(s) that achieve the highest energy savings and are life cycle cost-effective



Example Design Problem

Envision 10 ECMs you could do to improve the energy efficiency of your design that will also get you "credit". These 10 ECMs can be combined in 1023 different ways in your building, ranging from any one ECM to all 10 ECMs.

How do you decide what combination of ECMs is best to achieve the energy savings you want and to achieve the life cycle cost-effectiveness you need?

Potential Answers to Example Design Problem

1. You pick the ECM you think is most likely to work and then add new ECMs to your model one at a time until you get something you are happy with.

2. You perform a lot of simulations of energy savings and cost-effectiveness and pick the combination that best fits your needs.

Either way can require a lot of effort.

Using Energy Modeling Building Simulations

- Help with achieving baseline standard and the requirement to be 30% more efficient if cost effective
- When 30% more efficient is not cost effective, then incrementally decreasing until life cycle cost effective
- Keep the design feasible, both technically and economically, while responding to the local climate and other variables

Energy Plus Open Studio

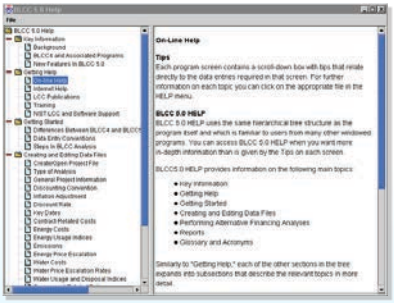
Graphical energy-modeling tool

- visualization and editing of schedules
- editing of loads constructions and materials
- interface to apply resources to spaces and zones
- visual HVAC and service water heating design
- high level results visualization
- **Parametric analyses**
- **Links to cost effectiveness**

Applying "Life Cycle Cost Effective"

Life Cycle Cost is the sum of all relevant project costs over a given study period, adjusted for the time value of money

BLCC5 is a National Institute of Standards software useful for evaluating energy and water conservation projects in buildings



http://apps1.eere.energy.gov/buildings/tools_directory/software.cfm/ID=88/pagename=alpha_list_sub

Applying "Life Cycle Cost Effective"

The particular application of BLCC ***most appropriate*** to the Federal building energy efficiency standards is **"optimizing interdependent system alternatives"**

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Innovative Designs in Federal Buildings: Success Stories

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NREL Research Support Facility, Golden, Colorado

- Office building occupied by the National Renewable Energy Laboratory
- Indirect goal to achieve 50% better than ASHRAE 90.1-2004
- LEED Platinum certified office
- EUI goal of 35 KBtu/sf/year or less (including data center)
- $261 per square foot to build

Source:
http://www.nrel.gov/sustainable_nrel/rsf.html

Featured in First Thursday Seminar #24

Federal Center South Building, Seattle

- Low-rise office building occupied by US Army Corp of Engineers
- Goal to achieve 30% better than ASHRAE 90.1-2007; model says 40% better
- LEED Gold certified
- EUI of 27.6 KBtu/sf/year or less
- Minimum Energy Star Score of 97
- $270 per square foot to build

Source: Whole Building Design Guide
http://www.wbdg.org/references/cs_fcsb1202.php

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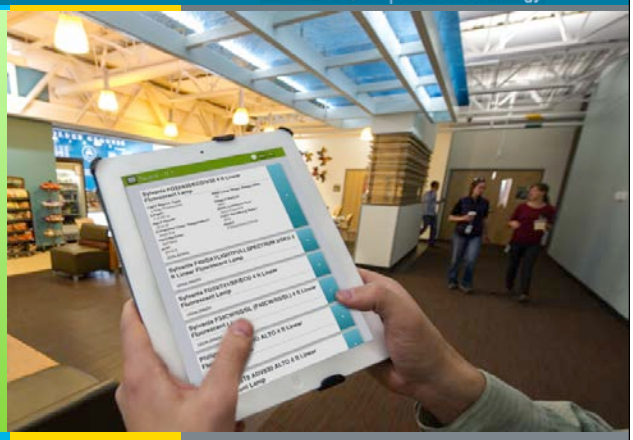
Essential Resources



Energy Modeling, Building Simulation

DOE Energy Plus

http://apps1.eere.energy.gov/buildings/energyplus/

Open Studio

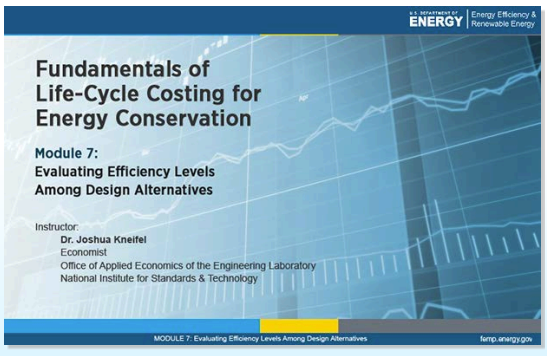
http://openstudio.nrel.gov/openstudio-application-getting-started

e-Training: Life Cycle Cost Analysis

Fundamentals of Life Cycle Costing for Energy Conservation

- Online, self-paced training
- CEUs offered

femp.energy.gov/training



Energy Efficient Technologies

Training: Energy Efficient Federal Purchasing

http://www.wbdg.org/education/femp13.php

FEMP website

http://energy.gov/eere/femp/energy-efficient-product-procurement

ENERGY STAR

https://www.energystar.gov

National Institute of Building Sciences

Whole Building Design Guide

www.wbdg.org

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